[*Extract from Transactions of the Canadian Institute, 1890.*]

11.

THE FORMATION OF TORONTO ISLAND.

By L. J. Clark, Esq.

(Read 26th April, 1890.)

My attention has been somewhat abnormally directed towards the lake, and to lake surroundings, and lake currents during the last two or three years, and, in the course of my investigations, I became aware that there were different theories, particularly as regards lake currents and Island formation. Without very much external aid on the subject, but by a careful process of deductive reasoning, I formed a theory, which, like all young theorists, I considered quite unassailable, and which I still view in the same light, but, alas, my theory is not new.

I have found, since making a more critical study of the subject, that it received a very large share of attention nearly half a century ago, by men who have made a name and fame for themselves, not only in Canada, but in other lands as well, in connection with questions of world-wide interest, in one instance at least, and who are still alive and in a position to compare their past theory of what the future of the Island would be with what it really is. I refer to such men as Mr. Sandford Fleming, Mr. Kivas Tully, Mr. Henry Yule Hind, and Mr. Hugh Richardson.*

I find there is quite a wealth of literature on the subject, which I have read with great interest, and which in the main agrees as to the source whence the material, forming the Island, is derived. I have also placed under contribution that never failing source of information, "the oldest inhabitant," and I now place before you the united results of my cogitations on the subject.

At the outset, I will call attention to two theories that have been put forward, but which on examination, I think, will be found insufficient for the purpose. The *first* is that the Niagara River has been a factor in the Island formation in this way. It is said that the direction of the river at its mouth is in a line with Scarboro' Heights, that the great volume of water makes straight across the lake, strikes the north shore, deflects to the west, and carries along the material from the Heights, of which the Island is formed. I heard a gentleman say that this was the

* Mr. Richardson is dead.

producing cause, and that the portion of the Island around where the lighthouse stands was the first to make its appearance.

To disprove this theory, it is only necessary to say that the velocity of the waters of the Niagara River at its mouth is not sufficient to transport the weighty materials of which the greater part of the Island is formed. To move the heavy shale, which forms a considerable part of the Island, would require a velocity of from five to eight feet per second. So that, if it lost none of its velocity in crossing it would not be able for the work. But that is in the region of the unthinkable. It is pretty well established that the temperature of the water of the Niagara River is raised one or more degrees, by the concussion of the Falls and the rough treatment it receives in coming through the rapids. It would, consequently, be lighter than the water of Lake Ontario, and would spread out, to a certain extent, over the surface, and thus, through increased friction, lose a part of its velocity. This has been well established by the fact that after great freshets that have been sufficient to give turbidity to the water of the river, it has been noticed that five miles out from the shore the discolored water has extended five miles to the east and west. By the time it would get across it would be a mere attenuated film on the surface of the lake, weak in its current and subject to the influence of every "breeze that blows." So that we may hardly look for it to gather up its dissipated energies for the herculean task of building up the Island. But the very fact that the Niagara River deposits its detritus in a bar near its own mouth ought to be sufficient evidence that it will not have strength to load up again when it gets across to this side. Mr. Fleming says "such a theory is wild and incapable of defence, though some are bold enough to venture it."

The other theory is that the material has been brought down by the Don, Humber and other streams to the west. But this theory fails as far as the Humber and Mimico Rivers are concerned, inasmuch as there is a depth of 90 feet of water between the outlet of the Bay and the Lighthouse Point, across which it would be impossible to transport the material of the Island without leaving some traces on its route.

And if the Humber has excavated its huge channel for 30 miles or more in length, and from ¼ to ½ a mile in width, and from 100 to 200 feet in depth, without contributing directly to the formation of the Island, we may naturally suppose the same of the Don.

I say directly, because I believe these streams have contributed to the stratum of clay that underlies the Island and extends out to an unknown distance into the lake.

In this connection, it is interesting to investigate the history of these streams. And, in order to do so, it will be necessary for us to go back to a period anterior to the subsidence of the waters to their present level. All indications point to an ancient lake beach at the foot of the cliff or terrace, which is situated just north of the present limits of Toronto, and which runs parallel with the shore at a distance ranging from nothing at Scarboro' Heights to two or three or more miles in other places. The evidence is pretty strong that the water remained at this level for a somewhat lengthened period. And here I must call attention to a difference of opinion entertained by our two previously mentioned friends, Mr. Fleming and Mr. Hind. Mr. Hind interprets Mr. Fleming to say, that at the time of the subsidence of the water to its present level the Don began to exist. Mr. Hind takes exception to that view, and I think correctly. For we cannot imagine the large section of land, forming nearly the whole of this Province as at present, without any water-courses. But, on the contrary, the first acre that appeared above the surface of the water would have its miniature streams, and, as the continent gradually emerged from the water, these channels would become longer and broader and deeper. And I believe that when the lake stood at its former level, the Don, Humber and other streams existed pretty much as they do now, the only difference being that their mouths were situated at the then existing shore-line. Remember, I do not say that Mr. Fleming says what Mr. Hind says he does.

Now, we can easily discover what became of the immense amount of detritus brought down by those streams. It formed the present site of Toronto, and the stratum of clay that extends out under the Island and to an indefinite distance beyond. The sandy portions we find deposited first near the ancient beach and the clay farther removed, and as we would naturally expect, the Humber being the mightier of the two rivers, the greater was the amount of material brought down, and the more would the bed of the lake be filled up, so we find the land higher in proximity to the Humber, and the descent is from the west to the east. This accounts for the numerous ravines that were washed out in the present site of Toronto after the subsidence of the water, all having a general direction from N.W. to S.E. One word more as to what caused the subsidence of the water to its present level. The writers I have previously referred to, do not throw much light on that part of the subject but, fortunately the President of the American Association for the Advancement of Science, in a lecture delivered in this city last year, showed very conclusively that it was owing to the melting away of an immense glacier or ice-field that extended along our northern shore and cut off the exit of the water by the St. Lawrence. Previous to that time,

it is supposed the water of the great chain of lakes found its way to the sea by an outlet in a south-easterly direction, through Rome—this is not the one we hear so much about in politics—and Utica, and down the Hudson River. When this great barrier melted away, the outlet took its present course, and the lake assumed its present level.

On the subsidence of the lake to its present level, all the Don and other streams had to do was to excavate from their former terminus to the new shore line. And I would call the attention of my hearers to the much more ancient appearance of the banks of the Don, for instance, in what I may style the old part than the new. This may be very well seen on some of the C.P.R. bridges that happen to be near or at the terrace.

Now, having told you how the Island was *not* formed, I shall endeavor to tell you briefly how it *was* formed ; and, in doing so, I shall keep very close to Mr. Fleming's exposition of the case. The other writers referred to all give Mr. Fleming the credit for first enunciating the true solution of the problem. And I cannot do better than call your attention to a copy of some of the maps and drawings that he has used to explain his theory.

The limited time at my disposal will only allow me to make brief reference to the salient features of the probable solution.

First, the material of which the Island is formed came originally from the Scarboro' Heights ;

Second, the mechanical force which transported the material to its present resting place was the storm action of the waves, which is now as active as ever.

In proof of the first premise we find the material on all parts of the Island to be identical in its nature with that composing the Heights: Prof. Pike informed me that he had made an examination of the material from both places and he found them to be of the same geological formation. Then its continuous connection, until recently, with those cliffs to the east, is also evidence to the same effect.

In proof of the second premise, we have the well authenticated fact of the gradual extension of the Island to the westward. Mr. Hind points out that previous to his time it was ascertained that thirty acres had been added to Lighthouse Point from the time of the first surveys. I was credibly informed, a few days since, by an old citizen that he remembered when the Lighthouse was close to the beach.

Wave action on a beach is tolerably well understood. When the direction of the wave or wind is perpendicular to the beach the effect is entirely

destructive. The waters, in their agitation, become loaded with sand and other material, which it bears away as the waves recede, and which it deposits at various distances from the shore according to its fineness or coarseness. Some of it will be carried out to such deep water as to be beyond the influence of the waves to bring it back again. This is entirely destructive. But when the waves inpinge on the beach at an angle it causes an onward movement of the material of the beach. This is clearly shown in Figures I. and II. The particles held in suspension are thrown up the incline in the direction of the wave, and when the force is spent it moves back towards the water-line in the most direct course, that is perpendicular. The lighter parts will be carried higher and moved to a greater distance forward as shown in Figure II. Thus we find the fine sand away to westward, while the heavier portions remain along the bar in front of Ashbridge's Bay.

During violent storms, astonishing changes take place in the beach. A summer sojourner at Balmy Beach informed me that, during the great storm of 1885 or 1886, when the Lake Shore Road, near the Humber, was washed away, the whole of the beach from the Heights to the head of Ashbridge's Bay, with the exception of a few hundred feet in front of his own place, was washed away. The same gentleman informed me that large boulders, sometimes weighing hundreds of pounds made their appearance after storms and became permanent landmarks, unless taken by the pleasure-seekers of the locality to form rockeries to adorn their front yards.

This shows the great transporting power of water when in motion. But proof of that need hardly be cited at this day when some of the greatest disasters to life the world has ever known, have been attributable to the uncontrolled fury of water when broken loose from its bounds, as, for instance, the Johnstown disaster.

Mr. Sandford Fleming supposed that when the last subsidence of water took place, instead of there being an abrupt cliff at Scarboro', as at present, the land fell off in easy slopes to the water's edge, as shown in Figures III. and IV. Then, owing to the long reach of 180 miles of lake to the east, the immense waves raised by the easterly winds began to produce their abrading effects on said promontory, and the abraded material was carried and deposited to the west, forming a spur, as in Figure V. The same action continuing produced results as shown in Figures VI., VII., and VIII., until we have our present harbor.

Mr. Hind takes objection slightly to Mr. Fleming's view of the promontory extending such a distance into the lake. He bases his objection

on the fact that the depth of water at about one mile from shore is 48 feet,—I verified this fact myself last summer, so that there has been little change in 40 years,—and this he considers to be below the depth at which wave action would be felt, or produce much effect. And this seems reasonable, for at a distance of about 2000 feet from shore we meet with a ridge, the top of which is only about 26 feet below the surface, although on either side it quickly falls away to 33 feet. Now, if the waves had much of an erosive effect at over 26 feet in depth, it would probably remove the top of this ridge, but I found it there last summer just where Mr. Rust found it several years ago when taking soundings of that part of the lake.

But, on the other hand, it occurs to me that if the cliff had formerly extended only a few hundred or even a thousand feet farther south than at present, the bar which now encloses Ashbridge's Bay, would have been driven right on the mainland and have formed a beach, as there appears to have been no stream there sufficient to head it off, as the Don might be capable of doing when it got further west. However, this is not a point of vital importance to the existence of the Island.

It may be claimed that storms from the west would have a counteracting influence. Of course they would, but only in the ratio of 40 : 180, other things being equal. And this, no doubt, accounts for the somewhat peculiar coast-line on the city side of the Island. High and low lake level periods, which have been known to recur at irregular intervals, also had something to do with the irregularity of the said coast-line. According to the American Engineer's Report, between the years 1825 and 1838, Lake Ontario rose nearly 7 feet and Lake Erie nearly the same, which would change the appearance of the Island very much. But it is not necessary to pursue that phase of the subject further.

The phenomena of travelling beaches and deposits, similar to the one under consideration, are by no means rare. One, on a small scale, that came under my own observation, and with which many of you may be familiar, occurs near Grimsby, at what is called the lily pond. The cliffs to the east consist of drift clay containing small fragmentary portions of rock entirely unwater-worn. As the cliff becomes undermined, portions break loose and fall into the water. The clayey portions become dissolved, and are carried out to be deposited on the lake bottom, while the fragmentary rocks become water-worn, and are driven westward where they have formed a ridge six or eight feet in height and fifty feet in width across the mouth of the pond, leaving the opening at the very western side.

Another place I visited last summer, viz.: Irondequoit Bay, near Rochester, presents a similar feature. Mr. Hind calls attention to it in 1854. He says that the opening was then ¼ of a mile farther west than it was formerly, and was becoming shallower.

The mouth of the Aux Sables, in Lake Huron, presents a remarkable illustration of the onward progress of a beach in the direction of the prevailing winds.

Rondeau Harbor, in Lake Erie, is almost a fac simile of Toronto Harbor, and many other examples will occur to you on a little reflection.

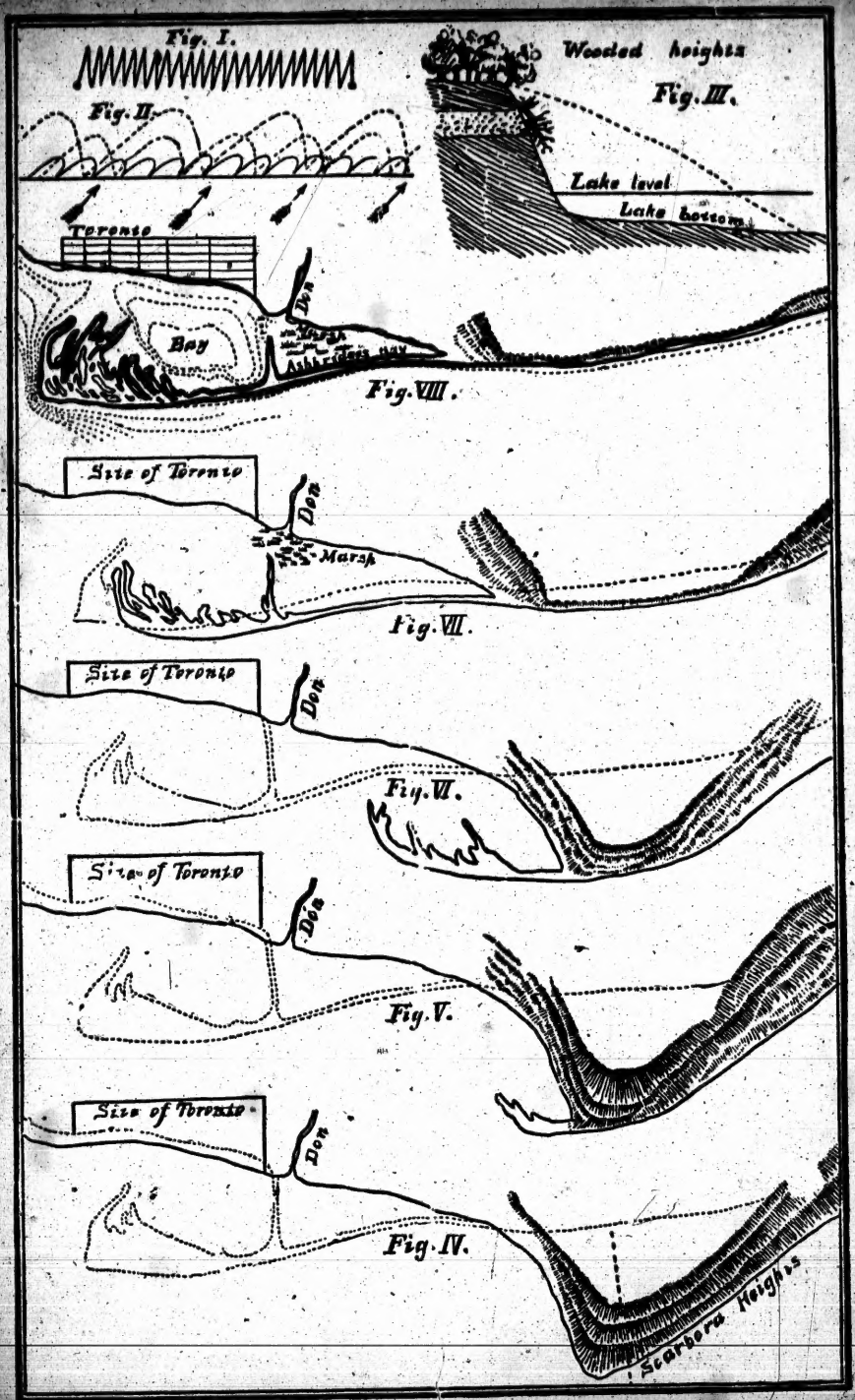
If I had time, I would like to call attention to the formation of the marsh. In the early history of the Don, no doubt, it poured its waters directly into the lake, while the spur, shown in Figure V., was in its infancy, and, at the time it was following Greeley's advice under the powerful influence of the easterly storms, the Don was also trying to obey the same injunction by turning, if not its face, at least its mouth toward the west. But the embryo Island grew more rapidly and soon overhauled the Don, and after a lengthened period of high lake level during which time the young giant was working unseen, came a period of low level, when the Don found its progress menaced by the spit of sand running northward to near the site of the old windmill. I have examined various maps of Toronto for the purpose of obtaining light on this part of my subject. The earliest is Bouchette's, which was made in 1793. This shows that the bar running northward had entirely closed the present mouth of the Don, and that another mouth existed about half way between the mainland and the present gap. At this time, I believe, began the deposits which formed the marsh.

Mr. Lawson, tea merchant, King Street, informs me that he remembers both mouths, the latter being called the big mouth.

Before the Island afforded the protection it does at present these mouths may have been constantly shifting, and at times both may have been closed up. Indeed, some writers tell us distinctly that such has been the case, and that the water of the Don had no visible out-let, but made its way out by filtration through the bar. At such a time sedimentation would go on rapidly.

This is pretty much my own theory—at least I don't saddle it on any one else, though others may have a prior claim to it.

However interesting the subject of the Island formation may be to the scientist, Island preservation is of far greater interest to the financier and business man of Toronto. The reports that reach us of the destruction going on at the east end of the Island are of an alarming character, and it behooves our city guardians to take steps for its preservation before our beautiful Island vanishes from our sight.



Drawing Showing the Development of Toronto Harbor.